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(54) Heat exchanger and method for manufacturing the same

(57) A heat exchanger (1) includes a header pipe (2, 3) comprising a header pipe body (6) and connecting portions (13, 14) projecting outwardly from the surface of the header pipe body (6) and connected to each other at a plane contact condition. A joint block (16) or a bracket (15) is connected to header pipe (2, 3) so that the joint block (16) or bracket (15) is brought into contact with both the header pipe body (6) and one or two connecting portions (13, 14). The joint block (16) or bracket (15) is precisely positioned relative to header pipe (2, 3), and a good brazing property therebetween can be achieved.

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Description

The present invention relates to a heat exchanger suitable for use in automobiles and a method for manufacturing the heat exchanger.

A heat exchanger, for example, used as a condenser or as an evaporator for an air conditioner in automobiles, typically comprises a pair of header pipes, a plurality of heat transfer tubes interconnecting the pair of header pipes, and fins disposed between the heat transfer tubes. Such a heat exchanger is usually attached to another member (for example, a member disposed in a engine room or a vehicle frame) via brackets. The brackets are attached to, for example, a pair of header pipes 51 and 52, as shown in Figs. 9 and 10. Header pipe 51 (or 52) is usually formed as a circular cross section. Bracket 53 has a curved portion (R portion) 54 formed along the outer surface of header pipe 51 (or 52), and R portion 54 is brazed to the outer surface of header pipe 51 (or 52).

When bracket 53 is attached to header pipe 51 (or 52), generally, R portion 54 is temporarily fixed to the outer surface of header pipe 51 (or 52) by, for example, MIG spot welding, and thereafter, bracket 53 is brazed to header pipe 51 (or 52). In the brazing process, because the outer surface of header pipe 51 (or 52) is curved, bracket 53 is likely to rotate or move along the outer surface. Therefore, it is often difficult to set or fix bracket 53 at a proper position relative to header pipe 51 (or 52) and to braze bracket 53 at the proper position. Moreover, an undesired gap 55 may be formed between R portion 54 of bracket 53 and the outer surface of header pipe 51 (or 52), and this gap 55 may cause a defect of brazing.

To solve such problems, the applicant of the present invention previously proposed an improved structure in Japanese Utility Model Laid-Open HEI 3-64375. In the proposal, as shown in Fig. 11, header pipe 56 is formed by curling a longitudinal flat plate to form a pipe portion 57. Header pipe 56 has connecting portions 58 and 59 formed by folding the lateral end portions of the longitudinal flat plate and bringing the surfaces of the lateral end portions into contact with each other so that the connecting portions 58 and 59 project from the outer surface of pipe portion 57. Bracket 60 is connected to connecting portions 58 and 59. Bracket 60 has a holding portion 61, and bracket 60 is fixed to header pipe 56 at a predetermined position by fastening holding portion 61 onto connecting portions 58 with bolts 62.

In the structure, since bracket 60 is connected to connecting portions 58 and 59 projecting from the outer surface of pipe portion 57, the working for positioning and connecting of bracket 60 may be improved. Further, the strength of header pipe 56 may be increased by the contact structure of connecting portions 58 and 59. However, because bracket 60 is attached at an outer side of connecting portions 58 and 59 in the width direction of a heat exchanger, the total width of the heat exchanger including bracket 60 becomes greater. Further, when a bracket is required to be attached on the outer surface of pipe portion 57, the aforementioned problem, that is, the rotation of the bracket at its positioning or fixing, cannot be solved.

Accordingly, it would be desirable to provide an improved structure of a heat exchanger in which a joint block for piping or a bracket may be more easily positioned relative to a header pipe at a proper position, and a method for manufacturing the heat exchanger, thereby achieving more precise positioning and better brazing condition of the joint block or bracket.

Further, it would be desirable to provide an improved structure of the heat exchanger capable of reducing the total size of the heat exchanger including the joint block or bracket.

A structure of a heat exchanger according to the present invention is herein provided. The heat exchanger includes at least a header pipe. The header pipe comprises a header pipe body formed as a tube and two connecting portions projecting outwardly from the header pipe body and connected to each other at a plane contact condition. A joint block for piping or a bracket is connected to the header pipe at a condition in which the joint block or bracket is brought into contact with both the header pipe body and one or both of the two connecting portions.

The joint block or bracket may have a holding portion nipping two connecting portions from both sides. A heat medium inlet portion and/or outlet portion may be formed on the header pipe integrally with the header pipe.

The heat exchanger typically comprises a pair of header pipes, a plurality of heat transfer tubes interconnecting the pair of header pipes, and a plurality of fins disposed between the respective adjacent heat transfer tubes.

Further, a method for manufacturing a heat exchanger according to the present invention is characterized in that both lateral end portions of a longitudinal flat plate for forming a header pipe are folded, the longitudinal flat plate is bent in its transverse direction to form a tubular header pipe body by curling a central portion of the longitudinal flat plate and to form an engaging portion projecting from the tubular header pipe body by bringing surfaces of the folded lateral end portions into contact with each other, and a joint block for piping or a bracket is positioned relative to a formed header pipe by bringing the joint block or bracket into contact with both an outer surface of the header pipe body and a side surface of the engaging portion.

In the method, the joint block or bracket may have a holding portion for holding the engaging portion from both sides and the joint block or bracket may be temporarily fixed to the header pipe by caulking the holding portion to the engaging portion. Alternatively, the joint block or bracket may be temporarily fixed to the header pipe by fastening the joint block or bracket to the engag-

ing portion with a bolt. Further, the joint block or bracket may be fitted onto at least an end of the tubular header pipe body of the header pipe.

After the positioning of the joint block or bracket relative to the header pipe, or, after temporarily fixing the joint block or bracket to the header pipe after the positioning, the joint block or bracket may be brazed to the header pipe.

In the heat exchanger and the method for manufacturing the heat exchanger, the joint block or bracket is brought into contact with both the outer surface of the header pipe body and one or both of two connecting portion (that is, the side surface of the engaging portion formed by the folded lateral end portions). Therefore, since the joint block or bracket is regulated in position by two different portions of the header pipe, the joint block or bracket may be positioned at a proper position easily and precisely. Moreover, although the outer surface of the header pipe body is formed as a curved surface, because the joint block or bracket is brought into contact with the side surface of the engaging portion projecting from the header pipe body as well as with the outer surface of the header pipe body, the rotation of the joint block or bracket in the circumferential direction of the outer surface of the header pipe body may be prevented by the contact with the engaging portion. As a result, both of proper positioning and good fixing of the joint block or bracket relative to the header pipe may be achieved.

Moreover, since the joint block or bracket may be attached to the header pipe more closely to the header pipe body as compared the structure shown in Fig. 11, the total size of the heat exchanger in the width direction may be reduced.

Furthermore, the folded lateral end portions are brought into contact with each other to form the engaging portion (two connecting portions) at a plane contact condition, the strength of the formed header pipe may be greatly increased.

In the embodiment wherein the joint block or bracket has the holding portion and the holding portion is caulked to the engaging portion, or in the embodiment wherein the joint block or bracket is fastened to the engaging portion by a bolt, the joint block or bracket may be temporarily fixed to the header pipe more strongly, thereby achieving a desired brazing.

In the embodiment wherein the joint block or bracket is fitted onto at least an end of the tubular header pipe body of the header pipe, a precise positioning except positioning in the rotational direction may be achieved by the fitting structure, and at the same time, the rotation of the positioned joint block or bracket may be surely prevented by the contact with the engaging portion.

Further objects, features, and advantages of the present invention will be understood from the following detailed description of the preferred embodiments of the present invention with reference to the accompanying figures.

Embodiments of the invention are now described with reference to the accompanying figures, which are given by way of example only, and are not intended to limit the present invention.

Fig. 1 is a perspective view of a heat exchanger according to a first embodiment of the present invention.

Figs. 2A and 2B are perspective views of a longitudinal flat plate and formed header pipe therefrom, showing a process for forming the header pipe.

Fig. 3 is a cross-sectional view of a header pipe portion of the heat exchanger depicted in Fig. 1.

Figs. 4A and 4B are perspective views of an upper end portion of the header pipe of the heat exchanger depicted in Fig. 1, showing the process for temporarily fixing a joint block to the header pipe.

Fig. 5 is a partial perspective view of a heat exchanger according to a second embodiment of the present invention.

Fig. 6 is a partial perspective view of a header pipe of a heat exchanger according to a third embodiment of the present invention.

Fig. 7 is a partial side view of the header pipe depicted in Fig. 6 and a joint block attached thereto.

Fig. 8 is a cross-sectional view of the header pipe depicted in Fig. 7 as viewed along the line VIII-VIII of Fig. 7.

Fig. 9 is a partial elevational view of a header pipe portion of a conventional heat exchanger.

Fig. 10 is a cross-sectional view of the header pipe portion depicted in Fig. 9 as viewed along the line X-X of Fig. 9.

Fig. 11 is a perspective view of a header pipe portion of a heat exchanger disclosed in Japanese Utility Model Laid-Open HEI 3-64375.

Referring to Figs. 1 to 4, a heat exchanger of the present invention is provided according to a first embodiment. Heat exchanger 1 includes a pair of header pipes 2 and 3 disposed parallel to each other. A plurality of heat transfer tubes 4 disposed parallel to each other with a predetermined interval (for example, flat-type refrigerant tubes) fluidly interconnect the pair of header pipes 2 and 3. Corrugated fins 5 are interposed between the respective adjacent heat transfer tubes 4.

Header pipes 2 and 3 are manufactured as follows.

As depicted in Fig. 2A, a plurality of holes 9 for inserting tubes 4 thereinto are formed on a longitudinal flat plate 8. Both lateral end portions 11 and 12 are folded to form connecting portions 13 and 14. Forming of holes 9 and folding of lateral end portions 11 and 12 may be performed by a single process such as pressing. Next, as depicted in Fig. 2B, longitudinal flat plate 8 is bent by curling it at its central portion in the transverse direction to form a header pipe body 6 having a circular cross section and to bring the folded lateral end portions 11 and 12 into contact with each other at a plane contact condition. Thus, the folded lateral end portions 11 and 12 forms connecting portions 13 and 14 which project outwardly from the outer surface of header pipe body 6,

and the contact connecting portions 13 and 14 form an engaging portion 7 for positioning a joint block or a bracket in the manufacturing process.

Bracket 15 and joint block 16 are connected to header pipe 2 and 3 thus formed.

As depicted in Fig. 3, bracket 15 is disposed at a position on header pipe 2 (or 3) so that bracket 15 comes into contact with both the outer surface of header pipe 2 (or 3) and the side surface of engaging portion 7 (in this embodiment, the side surface of connecting portion 14). Because bracket 15 is regulated in position by different two portions, that is, the outer surface of header pipe 2 (or 3) and the side surface of engaging portion 7, bracket 15 may be positioned at a proper position easily and precisely as well as bracket 15 may be prevented from being rotated by the contact with the side surface of engaging portion 7. In such a condition, bracket 15 is temporarily fixed to header pipe 2 (or 3), for example, by MIG spot welding.

Joint block 16, as depicted in Fig. 4A, is disposed at an end portion of header pipe 2 (or 3). In this embodiment, joint block 16 has a fitting hole 16a, and joint block 16 is fitted onto the end portion of header pipe 2 (or 3). Fitting hole 16a may be formed either in correspondence with only tubular header pipe body 6, or in correspondence with both header pipe body 6 and engaging portion 7. Joint block 16 may be positioned on the end of header pipe 2 (or 3) precisely by the fitting structure, except in the rotational direction. The movement or rotation of joint block 16 in the rotational direction may be surely prevented by the contact with engaging portion 7. Therefore, joint block 16 may be precisely positioned in all directions. In this embodiment, after the positioning, a portion 16 b of joint block 16 is caulked onto engaging portion 7 to temporarily fix joint block 16 to header pipe 2 (or 3), as depicted in Fig. 4B.

The heat exchanger assembly thus attached with brackets 15 and joint blocks 16 is brazed integrally in a furnace. Since the respective brackets 15 and joint blocks 16 are precisely positioned and fixed at the respective proper positions, a good brazing property may be achieved and heat exchanger 1 having an excellent performance may be obtained.

Further, as depicted in Fig. 1, because brackets 15 can be disposed at the front side (or the rear side) of heat exchanger 1 while the above-described precise positioning is maintained, the total size of heat exchanger 1 including brackets 15 in the width direction of heat exchanger 1 may be greatly reduced. Moreover, by the presence of connecting portions 13 and 14, the strength of header pipes 2 and 3 greatly increases.

Fig. 5 depicts an upper end portion of a header pipe of a heat exchanger according to a second embodiment of the present invention. Header pipe 21 has a header pipe body 22 and connecting portions 23 and 24 projecting from the outer surface of header pipe body 22, similarly to that in the first embodiment. In this embodiment, joint block 25 having a pipe connecting hole 26 communicating with the interior of header pipe 21 is attached to header pipe 21. Joint block 25 is positioned so that joint block 25 comes into contact with both the outer surface of header pipe body 22 and the side surface of one of connecting portions 23 and 24. In this condition, joint block 25 is fixed to header pipe 21 by fastening joint block 25 to connecting portions 23 and 24 with a bolt 27.

In this embodiment, because joint block 25 is temporarily fixed to header pipe 21 by bolt 27 before brazing, the position of joint block 25 may be precisely maintained before and during brazing, thereby further improving brazing property. Of course, joint block 25 may be temporarily fixed by another method, for example, by MIG spot welding, without using a bolt.

Figs. 6 to 8 depict a portion of a header pipe of a heat exchanger according to a third embodiment of the present invention. In Fig. 6, header pipe 31 has a header pipe body 32 and connecting portions 33 and 34 projecting from the outer surface of header pipe body 32, similarly to that in the first embodiment. In this embodiment, when header pipe 31 is formed by bending, semicircular recessed portions 35 and 36 (or semicircular protruded portions) are formed on connecting portions 33 and 34 in advance. When connecting portions 33 and 34 are brought into contact with each other, a space between semicircular recessed portions 35 and 36 is formed as a heat medium inlet portion 37 or a heat medium outlet portion. This heat medium inlet portion 37 or a heat medium outlet portion is formed integrally with header pipe 31 easily, merely by the curling process for forming header pipe 31. As depicted in Fig. 7, joint block 38 having a hole 39 for external piping is connected to header pipe 31 so that hole 39 communicates with heat medium inlet portion 37. As depicted in Fig. 8, joint block 38 is brought into contact with both the outer surface of header pipe body 32 and the side surfaces of connecting portions 33 and 34. Joint block 38 has a holding portion 40, and holding portion 40 is caulked onto connecting portions 33 and 34 from both sides.

In such a structure, a heat medium inlet or outlet portion may be easily formed integrally with header pipe 31 utilizing the forming of header pipe 31, and joint block 38 may be precisely positioned and may be strongly fixed by caulking.

The present invention may be applied to any type heat exchanger having a header pipe. In particular, the present invention is suitable for multi-flow type heat exchangers used as a heater, a condenser or an evaporator for an air conditioner used in automobiles.

Claims

1. A heat exchanger including a header pipe characterized in that said header pipe comprises a header pipe body formed as a tube and two connecting portions projecting outwardly from said header pipe

body and connected to each other at a plane contact condition, and a joint block or bracket is connected to said header pipe at a condition in which said joint block or bracket is brought into contact with both said header pipe body and one or both of said two connecting portions.

2. The heat exchanger of claim 1, wherein said joint block or bracket has a holding portion nipping said two connecting portions from both sides.

3. The heat exchanger of claim 1 or 2, wherein a heat medium inlet portion and/or outlet portion is formed on said header pipe integrally with said header pipe.

4. The heat exchanger of any preceding claim, wherein said heat exchanger comprises a pair of header pipes, a plurality of heat transfer tubes interconnecting said pair of header pipes, and a plurality of fins disposed between the respective adjacent heat transfer tubes.

5. A method for manufacturing a heat exchanger characterized in that both lateral end portions of a longitudinal flat plate for forming a header pipe are folded, said longitudinal flat plate is bent in its transverse direction to form a tubular header pipe body by curling a central portion of said longitudinal flat plate and to form an engaging portion projecting from said tubular header pipe body by bringing surfaces of said folded lateral end portions into contact with each other, and a joint block or bracket is positioned relative to a formed header pipe by bringing said joint block or bracket into contact with both an outer surface of said header pipe body and a side surface of said engaging portion.

6. The method of claim 5, wherein said joint block or bracket has a holding portion for holding said engaging portion from both sides, and said joint block or bracket is temporarily fixed to said header pipe by caulking said holding portion to said engaging portion.

7. The method of claim 5, wherein said joint block or bracket is temporarily fixed to said header pipe by fastening said joint block or bracket to said engaging portion with a bolt.

8. The method of any of claims 5 to 7, wherein said joint block or bracket is fitted onto at least an end of said tubular header pipe body of said header pipe.

9. The method of any of claims 5 to 8, wherein, after said positioning of said joint block or bracket relative to said header pipe, or, after temporarily fixing said joint block or bracket to said header pipe after said positioning, said joint block or bracket is brazed to said header pipe.

FIG. 1

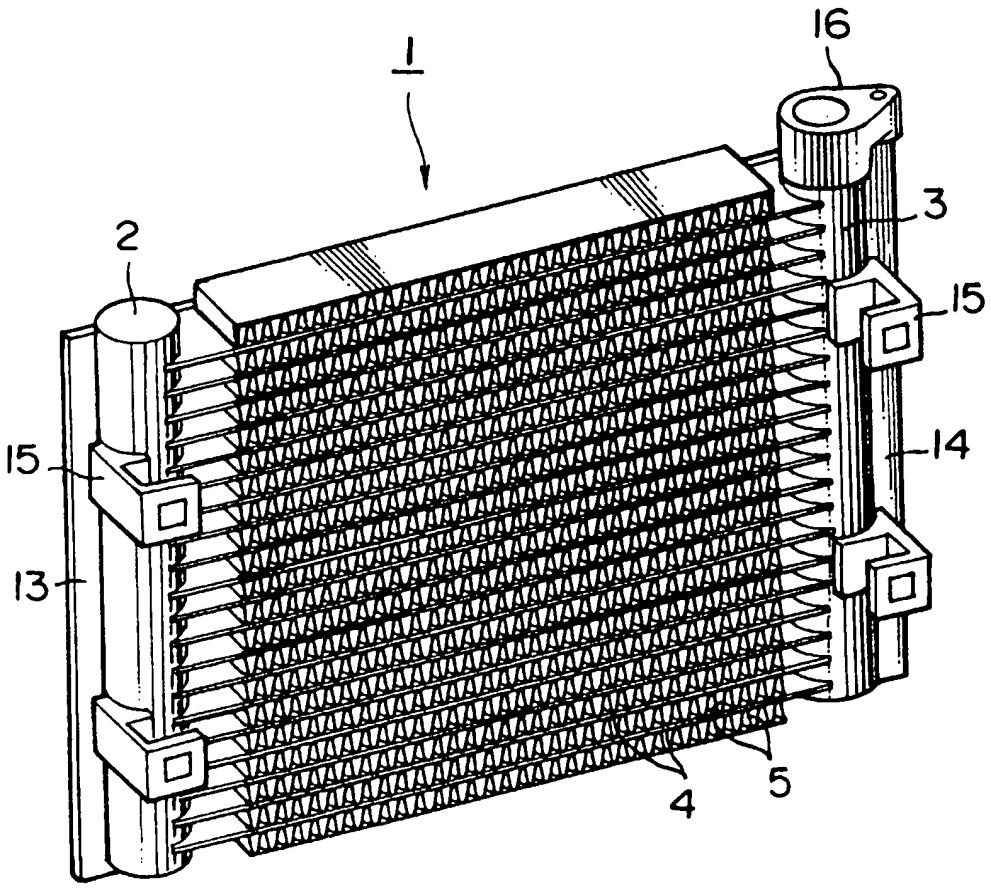

FIG. 2A

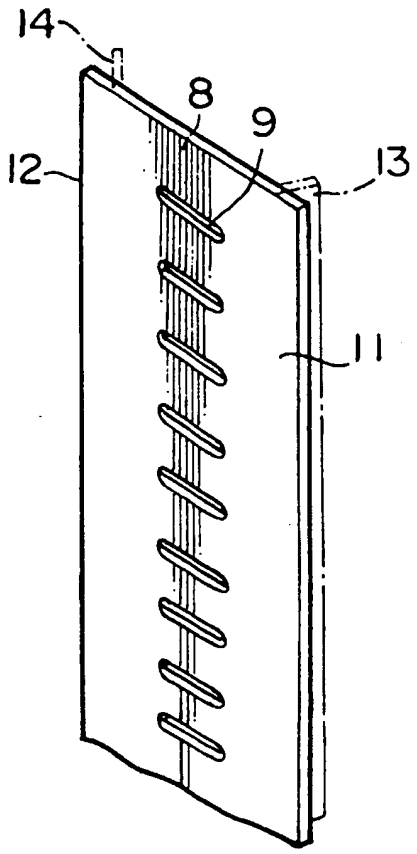

FIG. 2B

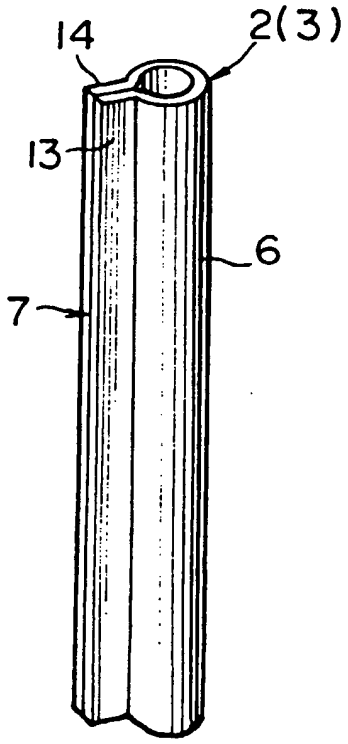

FIG. 3

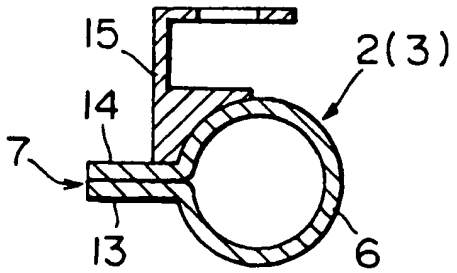

FIG. 4A

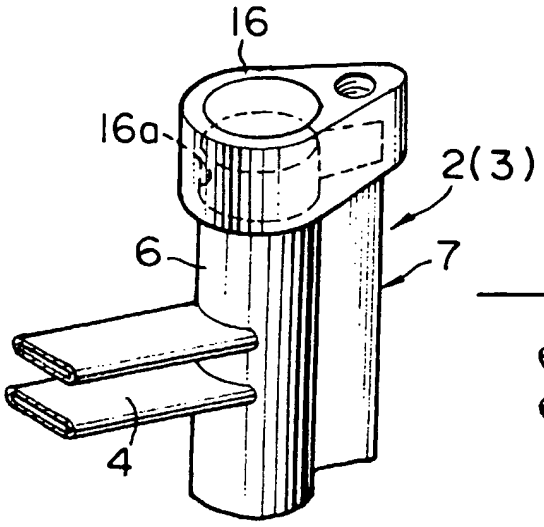

FIG. 4B

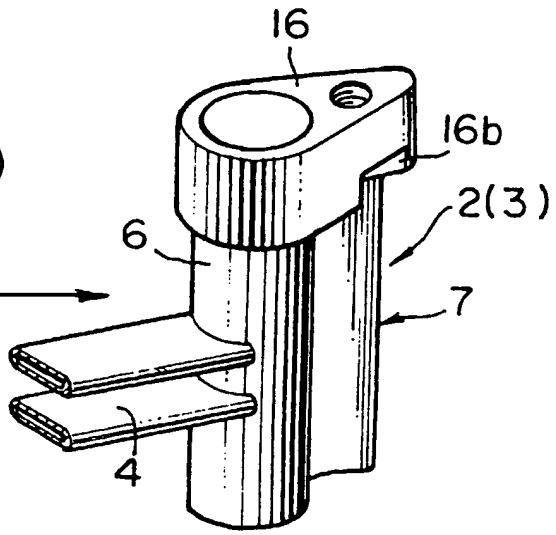

FIG. 5

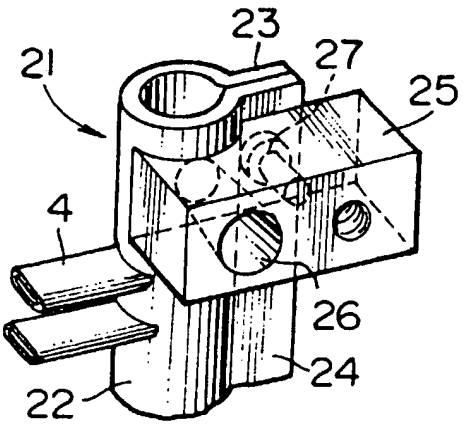

FIG. 6

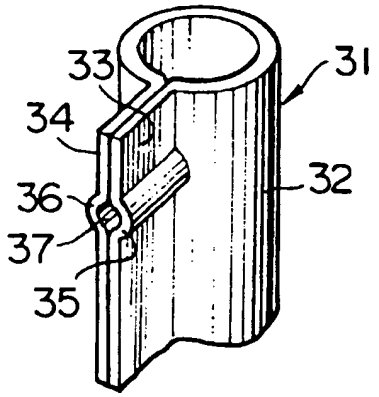

FIG. 7

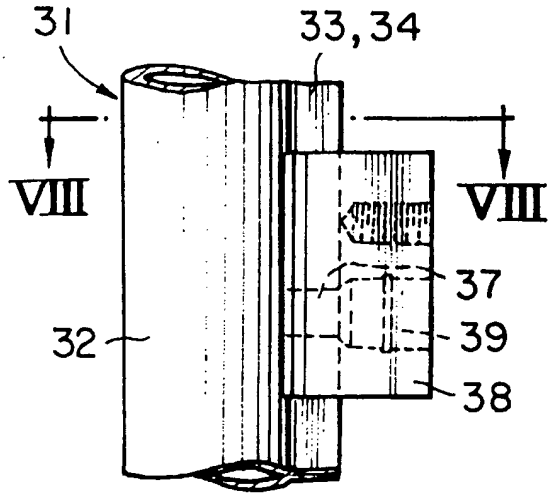

FIG. 8

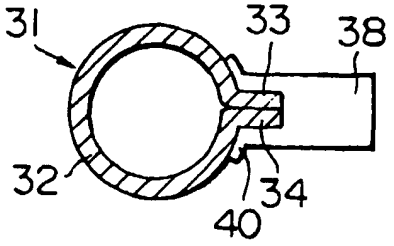

FIG. 9

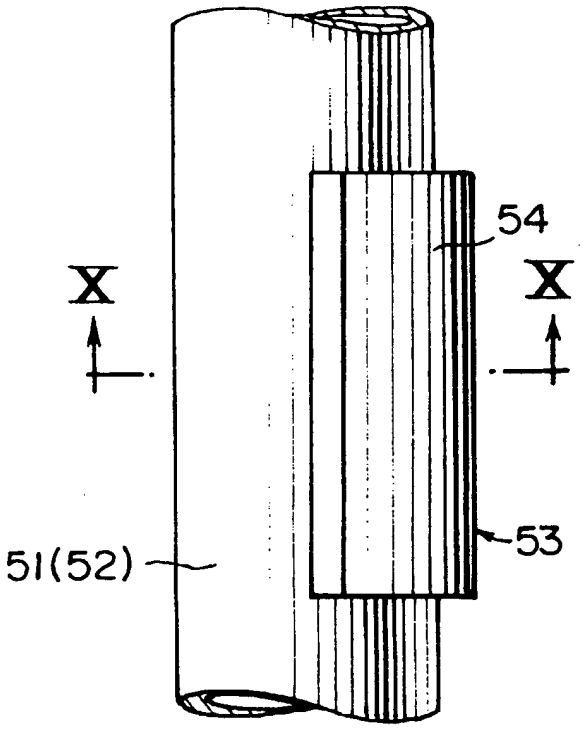

FIG. 10

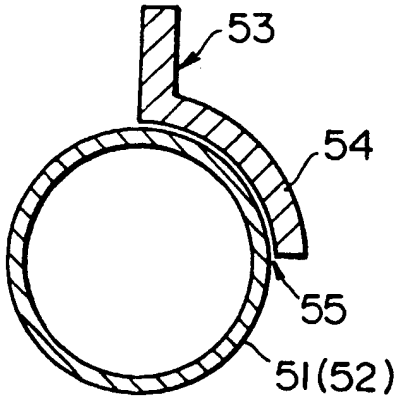

FIG. 11